GUIDANCE FOR REGULATORY EVALUATIONS:

A HANDBOOK FOR DOT BENEFIT-COST ANALYSIS

U.S. Department of Transportation
Office of the Assistant Secretary for Policy
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I. INTRODUCTION

Those operating administrations of the Department of Transportation which are charged by law with some regulatory functions must assure that the regulations that are developed, evaluated, and adopted can be fully justified. It must be adequately demonstrated that not only do the benefits of any proposed or existing regulation warrant the costs to various groups, but that it is superior to competing alternatives for achieving the desired goal.

This handbook has been prepared to provide guidance to the professional staffs engaged in these activities. The methodology for analyzing and appraising regulatory impacts can seldom be applied in direct "cookbook" style, because of the lack of data, the inability to measure, or the multiplicity of objectives and impacted agencies that permeate most transportation applications. In practice the analyst engaged in cost-benefit evaluations must often apply the methodology in an interpretive fashion using available techniques.

There is a standard set of elements or components that are required for any technically proficient cost-benefit analysis. Proper attention to these elements will make the final decision better and more defensible in the rule-making process itself and through the required clearance process. It will also allow senior officials and decisionmakers the means of rapidly assessing the rule's implications and assuring them that all important issues have been considered.

The purpose of this guidance is to assure that all DOT regulatory evaluations are done with a consistently high level of quality -- that they involve the requisite procedures for selecting alternatives, types of impacts, discount rate, price base, dollar conversion values, period of analysis, estimates of costs and benefits, ranking indicators, and sensitivity studies.

The sequence in which these components are addressed in an analysis is generally the sequence in which they are treated in this handbook, and the table of contents can serve as a suggested procedural outline. The checklist at the end of the handbook can serve as a useful reminder that key steps have been taken.

II. PROBLEM STATEMENT, ASSUMPTIONS, AND ALTERNATIVES

A. Statement of the Problem

The problem statement should concisely identify the concerns -- one or more -- that need to be remedied. It should explain why they cannot be corrected through market forces, and why the regulatory action is justified and will achieve the cited public goal. Care must be taken not to define the problem too broadly (making it difficult to target the regulation) or too narrowly (risking non-solution of the problem).

The problem statement should usually include a background statement which describes the issues, context, and implications of the problem statement. The background statement should include such considerations as: a brief history of the problem and past efforts to deal with it, including any present regulations which are to be reviewed; the extent to which the immediate problem is part of a larger problem; constraints which have worked against a solution; the effect of trends and changing technology; the consequence of the problem if not corrected; and groups which could suffer adverse effects from a change.

The analysis should clearly state the objectives of any existing regulations and any proposed action or actions. Regulatory objectives are to be chosen to maximize the net benefits to society (see Executive Order 12291, included as Appendix 1). Objectives of a regulation may be one-time or continual. They are sometimes specified in the legislation mandating development of particular regulations. More often, the objectives are stated in very general terms, leaving the interpretation of the objectives up to the agency.

B. Statement of Assumptions

When data are lacking or uncertain, or when it is necessary to limit the scope of an analysis, assumptions may be made to facilitate the analysis. Assumptions, while not absolutely verifiable, should be reasonable, logically credible, and supportable in comparison with alternative assumptions. Since assumptions underlying cost and benefit estimates are subject to challenge, it is important to retain all relevant information underlying an assumption in a form useful for future reference.

C. Choosing the Proper Level of Analysis

Since problems and regulations differ considerably in terms of costs and controversy, the appropriate level of analysis should also differ. Specifically, the level of analytic sophistication should depend on: (1) the intensity of public and Congressional interest and controversy; (2) the magnitude of costs and benefits accruing to various impacted groups and to the nation as a whole; (3) the time, manpower, and budget resources available for the analysis; and (4) data availability and cost of collecting additional data. Obviously, more effort should be spent analyzing a regulation which is controversial or imposes heavy costs on consumers, industry, or government than on a regulation which is not controversial or costly to any group or to the nation as a whole. For example, an economic assessment for an initial screening of an existing regulation, to determine if changes are needed, need not be as sophisticated as one required for an assessment associated with a rulemaking. A Regulatory Impact Analysis is the most stringent level of assessment; interim guidelines for conducting such an analysis, issued by the Office of Management and Budget, are contained in Appendix 2.

An evaluation can be quite informative even if it does not quantify or monetize all significant effects in great detail, provided that such effects are recognized and assessed qualitatively. For example, an uncontroversial regulation concerning the location of side lamps on trailers may only require a simple threshold analysis, while the analysis of a controversial noise reduction regulation involving major aircraft design changes would be substantially more complex.

Whichever level is chosen, the quality of the analysis should be sufficient to convince a reasonable and unbiased critic that any regulation selected for implementation is worthwhile to the nation as a whole. Refinements at various levels can include better data, improved estimates of costs and benefits, expanded impacts, more alternatives and impacted groups, sensitivity studies, and other considerations. When a formal Regulatory Impact Analysis is required, combining it with other required assessments (Regulatory Flexibility Analysis, EIS) in one document is permitted.

D. Identification of Alternatives

The search for and development of alternatives is more of an art than a science. Nevertheless, no regulatory analysis can be viewed as complete unless it can be demonstrated that the proposed or existing regulation adopted is the best alternative among all reasonable regulatory and non-regulatory alternatives. Considerable judgment is required to determine how many and which alternatives to use initially, and how to modify the number and types of alternatives as the impact evaluation is gradually refined. Improvising alternatives too hastily or selecting too few alternatives can result in overlooking the best solution, while selecting too many alternatives can result in excessive time required for analysis.

1. Definition of the Base Alternative. The first step in the identification of alternatives is to define the "base alternative" against which all other alternatives will be compared. The base alternative normally represents an estimate of the situation if there were no Federal regulation in place now and in the future. The base alternative for DOT regulations often represents the industry standard in the absence of government regulation, but it could also represent a situation in which state or local regulation would prevail. In any event, the base alternative is the standard against which the incremental costs and benefits of all other alternatives should be measured.

2. Generation of Other Alternatives. The next step is to seek, develop, and define one or more alternative actions (including retention, modification, or rescission of an existing regulation) that would mitigate or eliminate the concern being addressed. The initial alternatives can differ in only one simple feature such as implementation time, scale, or location, if these are the only significant and relevant variations. They can also differ in more fundamental ways, including market-oriented means of achieving the solution, such as providing better information and labeling, changing insurance programs, adopting new juridical approaches, using innovative technology, or introducing new economic incentives and disincentives in the form of fees, charges, or marketable permits. The alternatives do not necessarily have to be in DOT's power to implement. Institutional or legal constraints, such as agency jurisdiction, should not automatically preclude otherwise worthy alternatives. The alternatives may also differ in levels of stringency, to take into account the size and nature of the organizations being regulated, e.g., one alternative for facilities located in rural areas and another for those in urban areas.

When an existing regulation is under review, it should normally be considered one of the alternatives in the set, instead of the baseline, to assure that the cost of the existing regulation is assessed. An optional approach is to use the existing regulation as the baseline and to assess its cost by defining the "no-regulation" situation as one of the alternatives.

As more and better information becomes available, it should be used to refine alternatives. The quality and number of alternatives under consideration can change as the analysis is refined. Typically, however, several alternatives should be identified and simultaneously evaluated before considering changes in the set of alternatives.

The discussion should indicate constraints on any of the proposed alternatives; these constraints could be institutional, political, sociological, or legal, including any legislative mandate under which a proposed regulation is authorized or required. Such constraints should be carefully considered, since they must not be so overstated as to predispose the solution or rule out solutions which would be feasible if legislation were changed.

Frequently, some alternatives may be rejected prior to a detailed analysis so that attention can be focused on the most attractive alternatives. Some justifications for eliminating alternatives are: clearly unfavorable nationally aggregated impact; exorbitant cost; or severe implementation difficulties. All alternatives considered, even those rejected, should be recorded with their pros and cons.

III. ESTIMATION OF BENEFITS AND COSTS

Benefit-cost analysis in its broad interpretation is the process by which all significant impacts, including those that cannot be quantified, are taken into account and arrayed in an orderly fashion to facilitate good decisionmaking. The impacts of any alternative can take many forms, ranging from investment costs to environmental and aesthetic effects.

A. Elements of Impact Analysis

1. Identification of Impacted Groups. In order to properly assess the impact of regulatory alternatives, the analysis should take into account any significantly impacted group(s), including the general public, businesses, Federal government, State/local government, and others. The recently enacted Regulatory Flexibility Act requires consideration of impacts on small entities (small businesses, small governments, and small organizations). The positive and negative impacts on each affected group and on the nation as a whole should be identified, arrayed, and assessed in the decisionmaking process.

Any group should be further disaggregated into lower level groups whenever there is evidence of significant differential effects within the group, i.e., whenever an alternative may affect different subgroups in significantly different ways. Examples would be the differentiation between high and low income groups, consumers and industry, new-car buyers and used-car buyers. Thus, the appropriate number and definition of groups will vary from problem to problem.

2. Types of Impacts. Table 1 contains a checklist of types of effects which may be used as a starting point to identify impact in the evaluation of transportation projects. The list in Table 1 is illustrative, since any specific problem could lead to consideration of additional or fewer impact components.

Due to its broad definition, "impact" is open-ended, and as the analysis proceeds, there will be recognition that additional impacts must be included in order to fully differentiate among alternatives. Care must be exercised not to disregard an effect (such as air pollution) just because it is difficult to assess. In the review of an existing regulation, the consequences of having no regulation should be considered (such as existing or potential market, juridical, or state and local mechanisms that would function instead, as well as costs of rescinding the regulation).

3. Categorizing Impacts. In general, any positive impact is termed a benefit, while any negative impact is termed a cost. Cost-savings could be termed either a benefit or a negative cost; similarly, negative impacts such as environmental damage could be either a cost or a disbenefit. Using negative numbers appears to be overly complicated, and it is suggested that the simpler approach originally stated be used. In any case, the results should not be affected by the categorization if the analysis is done properly.

4. Types of Measures. Any evaluation would be simplified if all of the significant impacts of the alternative being analyzed could be readily expressed in monetary terms. However, in most analyses there may be a mix of different types of impact, as follows:

- Impacts which are already in monetary terms (e.g., construction costs)

Table 1. Illustrative Impact Components and Measures

	Impact 1/	Non-Dollar Impact Measure 2/
1.	Investment (including Divestment and Salvage) in Land, Improvements, Machinery, etc.	
2.	Expense and Revenues (User Charges, Materials, Labor, Rentals, Maintenance, Repairs, Sales, Taxes, Loan Receipts, Loan Payments, Subsidies, etc.)	
3.	Environment	Number of people exposed to various kinds and levels of pollution; polluti outflow
4.	Personal Safety	Number of fatalities; number and severity of injuries
5.	Energy	Energy usage (gallons, BTUs)
6.	Property Damage	
7.	Passenger Time	Passenger-hours delay for various modes.
8.	Cargo Time	Ton-days delay.
9.	Foreign Exchange	
10.	Paperwork Burden	
11.	Training and Education	
12.	Labor	
13.	Other (Comfort, Aesthetics, etc.)	

1/ Impacts 1-2 represent conventional accounting classifications, while the other impacts (except Foreign Exchange and Property Damage) are often not well represented by cash flows. Since the impacts are somewhat inter-dependent and overlapping, care must be exercised to properly account for all significant effects.

2/ Dollar conversion factors for these non-dollar impact measures are discussed in Appendix 3.

- Impacts which are quantifiable in monetary terms (e.g., consumer time expressed in terms of monetary units per hour of time saved or utilized)
- Impacts which are quantifiable but not in monetary terms (e.g., air or noise pollution measured in terms of pollutant particles per million or in decibels, respectively)
- Impacts which are considered non-quantifiable (e.g. aesthetic effects, loss of competition)

The above listing is in order of increasing difficulty in quantitatively assessing the impact. Regardless of the difficulty of expressing a type of impact in monetary terms, all significant impacts should be identified and taken into consideration as appropriate at each stage of the analysis.

As a general rule, even crude analysis of costs and benefits can be useful if discussed in the proper context. It is important, however, to state explicitly how reliable a given figure is. Where accuracy of data is doubtful, suitable caveats should be stated, surrogate measures used, or a sensitivity analysis performed. It is also extremely important to assure that monetary values used as a proxy for non-monetary impacts (e.g., value of time) are clearly identified, and that sensitivity analysis is performed where the choice of different monetary values would significantly affect the analytical results.

In the cost analysis, it is important to distinguish between real resource costs (e.g., labor or capital investment) and financial transfers (e.g., taxes or insurance premiums). Transfer payments should not be included in the calculation of real resource costs, but they should nevertheless be identified.

B. Estimation

1. Costs. Both direct and indirect costs are generated by regulations. Cost analysis methodologies include: engineering cost estimation, market

pricing, parametric costing, analogous costing, Delphi costing, prototype development, tear-down costing, and industry surveys using written questionnaires. These approaches may be used singly or in combinations to estimate the incremental costs of compliance.

2. Benefits. Quantification of benefits poses singular problems. In the case of cost-savings (such as paperwork reduction or time savings), hours saved and salaries not expended can be calculated. The benefits of a safety or environmental regulation are reduced damage, injury, and loss of life, representing the difference between the situation with a given alternative and that without it. Historical data, such as accident statistics and insurance claims, can be useful in making these estimates. Modeling is also used.

3. Conventions for Calculation of Costs and Benefits. A detailed discussion of suggested conventions for the calculation of costs and benefits is presented in Appendix 3. Included are economic lives for facilities or equipment, calculation of personnel and other administrative costs, time-phased costs and benefits, and suggested values of life and time.

IV. EVALUATION OF BENEFITS AND COSTS

There are a number of ways of evaluating the costs and benefits of regulatory alternatives once they have been estimated.

A. Basic Evaluation Techniques

The analysis and comparison of alternatives is usually based on one of three basic approaches:

- Numerical benefit-cost analysis involves only one measure, usually dollars, and the formulation allows the decision-maker to contrast directly dollars of benefit and dollars of cost. Its advantages are that it indicates whether the benefits of any alternative exceed its costs and permits ranking various alternatives by single-number indicators such as net benefit, breakeven year, and internal rate of return. An example of a summarized benefit-cost analysis of NHTSA's auto bumper standard is found in Table 2.

- When some significant impact components cannot be expressed in dollars or another common measure, a cost-effectiveness formulation is used. This is often applicable to safety work because of a general distaste and reluctance to try to quantify death and suffering in dollar terms. It avoids having to place a value on intangibles such as a human life and allows the decisionmaker to contrast alternatives in the form of ratios, such as fatalities forestalled per public dollar expenditure. An example of a cost-effectiveness array appears in column C of Table 3.

TABLE 2 - EXAMPLE, BENEFIT-COST SUMMARY

DEVELOPED FOR THIS EXAMPLE ONLY FROM NHTSA EVALUATION OF BUMPER STANDARD, APR 1981 *
ALL COSTS & BENEFITS IN 1979 DOLLARS PER CAR

	Cost or Benefit Component	Units	Base Case Pre-Standard (1972) F&R	F	R	Alternative 1 Present Std (Both Front & Rear)		Alternative 2 Present Standard Front Only		Alternative 3 Present Standard Rear Only		Alternative 4 1973 Std Front 5 MPH Rear 2½ MPH	
Costs	Purchase Cost of Bumper System	$	97	50	47	186		99		87		139	
	**Incremental Purchase Cost(Std-base) (one time cost,not discounted)	$					89**		49**		40**		42**
	Bumper System Weight	lbs.	79	41	38	118		63		55		126	
	Incremental Weight (Std-base)	lbs.				39		22		17		47	
	10 yr. Fuel cost for added weight	$				43		24		19		53	
	**Discounted Incremental Fuel Cost (10 years @ 10%)	$					36**		20**		16**		52**
	**Discounted Cost for Secondary Weight(.5 ratio @ $.60/lb)						30**		17**		13**		41**
	**TOTAL DISCOUNTED LIFE COST						155**		86**		69**		135**
Benefits	Cost per Unreported Damage Incident		159	188	127	168		166		171		139	
	Damage Incidents/car/year		.073	.040	.034	.058		.022		.036		.055	
	Damage Cost/car/year	$	11.61	7.42	4.34	9.74		3.72		6.14		7.65	
	Saving with Std./car/yr.(Base-std)	$				1.87		3.70		(1.80)		3.97	
	**Discounted 10 Year Saving	$					13**		25**		(12)**		38**
	Repair Cost per Insurance Claim	$	669	745	544	778		891		618		682	
	Number of Claims/car/year		.102	.0627	.0394	.0617		.0353		.0265		.0896	
	Claim Cost/car/year	$	68.24	46.71	21.43	48.00		31.45		16.38		61.11	
	Saving with Std./car/yr.(Base-std)	$				20.24		15.26		5.05		7.13	
	**Discounted 10 Year Saving	$					139**		105**		35**		69**
	**GROSS BENEFIT(UNREPORTED+CLAIMS)	$					152**		130**		23**		107**
	**NET BENEFIT (GROSS BENEFIT-COST)	$					(3)**		44**		(46)**		(28)**

* The April 1981 NHTSA document evaluates present and past bumper standards to assess the need for change -- it does not present or evaluate possible future standards. The process for evaluating future standards would, however, be the same.

** Starred numbers in the right hand column of the alternatives are actual components of the final net benefit. Other numbers for the base case and in the left hand column of the alternatives illustrate steps in the process. For instance, on the first line the purchase cost of the standard front & rear bumper system ($186) less the purchase cost of the base case front & rear system ($97) yields the incremental purchase cost ($89**).

Table 3

RANKING OF COUNTERMEASURES BY DECREASING COST EFFECTIVENESS IN PRESENT VALUE DOLLARS PER TOTAL FATALITIES FORESTALLED – 10-YEAR TOTAL

		COUNTERMEASURE	FATALITIES FORESTALLED (A)	COST ($ millions) (B)	DOLLARS PER FATALITY FORESTALLED (C)
1.	3101	Mandatory Safety Belt Usage	80,000	46.0	500
2.	2336	Highway Construction and Maintenance Practices	459	9.2	20,000
3.	1531	Upgrade Bicycle and Pedestrian Safety Curriculum Offerings	649	13.2	20,400
4.	1401	Nationwide 55 mph Speed Limit	31,900	676.0	21,200
5.	1232	Driver Improvement Schools	2,470	53.0	21,400
6.	2333	Regulatory and Warning Signs	3,670	175.0	34,000
7.	2203	Guardrail	3,160	108.0	34,100
8.	1532	Pedestrian Safety Information and Education	490	18.0	36,800
9.	2130	Skid Resistance	3,740	158.0	42,200
10.	2204	Bridge Rails and Parapets	1,520	69.0	46,000
11.	2331	Wrong-Way Entry Avoidance Techniques	779	38.5	49,400
12.	1331	Driver Improvement Schools for Young Offenders	692	38.3	57,500
13.	1601	Motorcycle Rider Safety Helmets	1,150	81.2	53,300
14.	1630	Motorcycle Lights-On Practice	65	5.2	80,600
15.	2202	Impact Absorbing Roadside Safety Devices	6,780	735.0	108,000
16.	2201	Breakaway Sign and Lighting Supports	3,250	379.0	116,000
17.	1431	Selective Traffic Enforcement	7,560	1,010.0	133,000
18.	1432	Combined Alcohol Safety Action Countermeasures	13,000	2,130.0	164,000
19.	1102	Citizen Assistance of Crash Victims	3,750	784.0	209,000
20.	2205	Median Barriers	529	121.0	228,000
21.	1530	Pedestrian and Bicycle Visibility Enhancement	1,440	332.0	230,000
22.	3130	Tire and Braking System Safety Critical Inspection—Selective	4,591	1,150.0	251,000
23.	1231	Warning Letters to Problem Drivers	192	50.5	263,000
24.	2230	Clear Roadside Recovery Area	533	151.0	284,000
25.	1334	Upgrade Education and Training for Beginning Drivers	3,050	1,170.0	385,000
26.	2138	Intersection Sight Distance	468	196.0	420,000
27.	1105	Combined Emergency Medical Countermeasures	8,000	4,300.0	538,000
28.	2332	Upgrade Traffic Signals and Systems	3,400	2,080.0	610,000
29.	2334	Roadway Lighting	750	710.0	936,000
30.	2131	Traffic Channelization	645	1,080.0	1,680,000
31.	3131	Periodic Motor Vehicle Inspection—Current Practice	1,840	3,890.0	2,120,000
32.	2330	Pavement Markings and Delineators	237	639.0	2,700,000
33.	2135	Selective Access Control for Safety	1,300	3,780.0	2,910,000
34.	2134	Bridge Widening	1,330	4,600.0	3,460,000
35.	2335	Railroad-Highway Grade Crossing Protection (Automatic gates excluded)	276	974.0	3,530,000
36.	2133	Paved or Stabilized Shoulders	928	5,380.0	5,800,000
37.	2132	Roadway Alignment and Gradient	590	4,530.0	7,680,000

NOTE: All figures have been rounded to three significant digits after internal computations were completed. All figures are subject to the caveats concerning precision of the data discussed in Chapter I, Section 1.3.

Source: U.S. DOT, The National Highway Safety Needs Report, Report of the Secretary of Transportation to the United States Congress pursuant to Section 225 of the Highway Safety Act of 1973.

Cases can arise when dealing with death and injuries where the cost-benefit form of analysis is desirable, and analysts have tried various methods of formulating a dollar value for the lives saved. Some analysts have tried to impute costs of death and injury by examining insurance claims paid. Others have tried to calculate how much society or the nation has shown itself willing to spend to forestall a fatality. Still others have imputed a dollar value on fatalities (and injuries) by tabulating the costs to society of the loss. These methods result in a minimum statement of the cost of the death (in the form of lost income and hospital and burial costs) that makes no attempt to quantify the pain, grief or suffering associated with it. Such estimates are found in Table A-1 of Appendix 3. Parameter values should be carefully chosen and justified, for they influence the final benefits calculation heavily.

When properly used, quantitative analysis of costs and benefits helps provide decisionmakers with a rational basis for examining and selecting alternatives. Both the analyst and decisionmaker must recognize, however, that assigning a numerical or dollar value to an uncertain impact does not remove the uncertainty, but could conceal it from the unwary. Therefore, complete information should be provided on any subjective judgments or relatively uncertain assumptions in the analysis.

- When significant costs or benefits cannot be reduced to a common measure, particularly when there is more than a single simple objective, it may be necessary to assess tradeoffs between

several sets of benefits and costs. In such analyses, the various costs and benefits are monetized or otherwise quantified where possible; all benefits and costs, including those that are nonquantifiable, are clearly set forth for each alternative; and the significant tradeoffs between the various costs and the benefits are explained.

B. Comparison of Benefits/Costs

1. Calculation of Present Value. Many of the costs (as well as the benefits) will be spaced out through time, and there may be both one-time and recurring costs. The analysis must take the differences and the time-phasing into account. This is accomplished by converting all future expenditures (and returns) into their value as of some common point in time, usually the year the decision is to be made. The process used is known as discounting, or present valuing. OMB Circular A-94 prescribes the use of a 10 percent discount rate for analyses submitted to the Office of Management and Budget in support of legislative and budget programs. Discounting should also be used in regulatory evaluations. However, the analyses should include the actual time-phased costs, possibly in an appendix, because the decisionmaker may want to consider alternative time phasings. An example of the application of the 10 percent discount rate in the calculation of present value is given in the OMB circular, which is included as Appendix 4.

2. Constant Dollars. In an era of inflation, the value of a dollar erodes through time. Therefore, not only must the stream of expenditures be converted to their relative value at a common point in time by the discounting described above, but they must also be converted to a common purchasing value. This is accomplished by the use of constant dollars, usually based in the year the decision is to be made. The advantage of

this procedure is that cost or expenditure estimates known in terms of today's dollars can be used, and the need to make estimates of future inflation rates is avoided. When cost estimates are available only in terms of future or past dollars, they may be converted to constant dollars through the use of various series of indices (e.g., the CPI, the GNP deflator). Use of these indices will vary with the application. The use of constant dollars eliminates the need to add inflation to dollar cost estimates.

3. Treatment of Uncertainty or Risk. An impact is said to be subject to uncertainty when it is not possible to predict or specify the magnitude of the impact within a narrow range. For example, regulatory analysis regarding airbags in automobiles gives rise to uncertainty with respect to both increased automobile costs as well as fatalities forestalled and injuries avoided: costs estimated by different sources vary by 50 percent or more, and there is comparable variability in estimated levels of benefits.

Two of the procedures for handling uncertainty or risk are listed below:

- Expected value approach (i.e., weighting of various possible consequences by the probability of each consequence occurring in order to find a weighted average or mean). When the probability distribution of an impact component is known, it is generally preferable to calculate an expected value of that component. This technique can be helpful for cases involving impacts with very high values and very low probabilities, such as regulation to lower the probability or consequences of a catastrophic accident. In these cases a decision is sometimes made to spend more than the expected value as a hedge against uncertainty.

- Pessimistic/optimistic approach (i.e., use of various possible values of impact components to determine the corresponding range of efficacy of the alternative). When the probability distribution of an impact component is not known, but the range of values is known, the analyst first performs the analysis using the lowest reasonable value of each benefit subject to uncertainty and the highest reasonable value of each cost subject to uncertainty (the pessimistic approach); and then performs the analysis using the highest reasonable value of benefits and the lowest reasonable level of costs (the optimistic approach). This method is a form of sensitivity analysis (discussed in the section that follows).

The expected value approach is preferable when the underlying probability distributions can be estimated, since it is relatively easy to understand, represents a weighted average of possible outcomes, and results in a single value for an impact subject to variability. If the necessary information for the expected value approach is not available, then the pessimistic/optimistic approach may be used. The two approaches may also be used in conjunction with each other. The methodology utilized to deal with uncertainty should be clearly identified and described in the evaluation report. A more detailed discussion of risk assessment is contained in Appendix 5.

4. Sensitivity Analysis. This type of analysis is usually applied in a situation where there are a few key measures about which there is a great deal of uncertainty. Instead of using expected values for these parameters, the analyst may use several values (e.g., high, medium, and low) in an attempt to see how sensitive the ranking of alternatives is to variations in the uncertain parameters.

The simplest way to begin sensitivity analysis is to vary only one input element at a time while keeping all others at their nominal level. Elements which can be varied include: estimates of impacts, dollar conversions of non-dollar measures, the discount rate, the period of analysis, and the design (e.g., timing, scaling, technology, and configuration) of the alternative. Timing studies, which indicate the effect of postponing or advancing a project, can be particularly useful. Financial controls such as user charges, taxes, and subsidies may also be varied.

If it is not feasible to do a complete sensitivity analysis, the most crucial candidates for variation should be those data estimates and assumptions which are considered especially uncertain or influential.

Contingency analysis is a variation on sensitivity analysis. This kind of analysis is the investigation of how the ranking of alternatives holds up when a relevant change in criteria for evaluating the alternatives is postulated, or a major change in the general environment is assumed. Expected levels of both benefits and costs may change considerably under contingency analyses, and may result in a different ranking of options.

V. PRESENTATION OF RESULTS

Once all costs and benefits have been calculated and assessed (including non-quantifiable costs and benefits), the results must be presented to the senior officials who will eventually be making the decision on which alternative course of action to adopt. Both they and subsequent reviewers must be satisfied that there is adequate information concerning the need for and consequences of the proposed action, that the potential benefits to society outweigh the potential costs, and that the best alternative is selected (as discussed below). Further, the decision-making officials must be assured that the proposed solution will in fact work as expected, and not result in a regulatory failure.

To do this, complete and concise information must be provided on each of the major alternatives. They should be ranked in order of preference, and it should be clear why the recommended alternative is the best solution. There should be an explanation of the mechanism by which each alternative is expected to yield the anticipated benefits. When only one feasible alternative to the base case is presented to a decisionmaker, that alternative must be demonstrably cost-beneficial, and indication must be given as why the problem cannot be handled in other ways.

A. Expressing Results

1. Numerical benefit-cost analysis. Numerical benefit-cost analysis allows several ways of comparing the merits of each alternative. One method is the ranking of alternatives by discounted net benefit, which is the remainder when present value incremental cost is subtracted from present value incremental benefit. An example appeared in Table 2. The present value benefits, costs, and net benefits of the proposed regulation

and each of the alternative approaches must be presented, along with costs and benefits that cannot be quantified in monetary or other terms (see also paragraph 3 below for discussion of presenting tradeoffs when there are non-monetized costs and benefits).

Alternatives may also be ranked according to the ratios of their present value benefits to present value costs (benefit-cost ratio), net benefit to cost ratio, or internal rate of return. These techniques and their advantages and disadvantages are discussed in several of the reference texts.* These less-frequently used techniques are appropriate in certain analysis; generally, OMB prefers the net present value technique.

Since it is not necessarily true that the alternative with either the highest quantitative net benefit or the best benefit/cost ratio is always the preferred solution, neither of these measures can be the sole decision criterion in every case. Neither takes into account the magnitude of the cost burdens or possible non-quantifiable benefits or costs. For example, regarding the question of cost magnitude, over a 10-year period Alternative A may indicate benefits of $8 billion, though costing $2 billion, while Alternative B may indicate benefits of $1.5 billion, though costing $500 million. The net benefit of A is $6 billion and its benefit-cost ratio 4:1; while the net benefit of B is $1 billion and its benefit-cost ration 3:1. Although A is more beneficial than B by both criteria, the decisionmaker must also weigh whether the nation or the industry can afford $2 billion in additional costs to achieve this objective, regardless of how meritorious it is.

* Note particularly Halvorsen and Ruby, pages 46-52, and Mishan, Cost-Benefit Analysis, pages 231-233.

2. Cost-effectiveness. In cases where benefits cannot be measured in dollars, it is sometimes possible to rank alternatives according to cost-effectiveness criteria. One technique, least cost for a given level of effectiveness, is applicable when more than one alternative can reach the desired level of effectiveness. A second, most effectiveness for a given cost constraint, is applicable when there is a limit on costs that can be expended to achieve an objective. The cost effectiveness ranking can be highly informative as to the overall merit of various alternatives as was seen in Table 3.

3. Tradeoffs involving non-quantifiable or non-commensurable benefits or costs. In general, the presentation of results should begin with costs and benefits that are measurable in dollars, followed by those that are non-monetary but quantifiable, and finally, those that are non-quantifiable.

Placing these last effects in context is one of the most difficult areas for the analyst and the senior official who must eventually decide on the action to be taken. Common kinds of non-quantifiable impacts (besides pain, grief, and suffering, noted previously) are new procedural or legal precedents, government intrusions into privacy, decreased or increased mobility, deterrence to innovation or productivity growth, forced shifts in employment status, or apparent inconsistencies with other government or Departmental policies.

When there are non-quantifiable benefits or costs, or where there are quantifiable benefits or costs that cannot be measured in the same scale (e.g., monetary costs vs. air quality benefits vs. savings of lives vs. noise benefits), these various costs and benefits should be discussed, and preferably displayed in tabular form. The major costs and the major benfits of each alternative should be succinctly summarized. Where possible, the

tradeoff implications of choosing each alternative should be identified. For example, for a pollution prevention rule the choice of one alternative may imply a certain marginal value of the cost of an oil spill avoided whereas the choice of another alternative may imply a different value. Sometimes there are a large number of non-commensurable factors and the traeoff analysis becomes quite complicated. In those cases, clarity of presentation is particularly important.

4. Impacts on Different Groups. If the benefits and/or costs are significantly differentiated by subgroup, the implications of this divergence should be noted so that the decisionmaker will be aware of it. The analyst should make no attempt to weight mathematically the impacts toward or away from a particular group in the net benefits calculations, but simply break out net benefits by subgroup. However, if this uneven impact is considered important, it may play a role in the choice of a recommended alternative; if so, it should be so noted and justified in the recommendations section.

B. Organizing the Report

The table of contents of this handbook represents a rough outline of a final report. The analysis of each alternative, including both estimation and evaluation, should be presented separately, beginning with the base case.

The final section of the evaluation should contain conclusions and recommendations for rulemaking. If the proposed regulation is not the most cost-beneficial of the alternatives discussed, this section should explain the legal and other reasons why it is recommended.

If none of the other alternatives is attractive vis-a-vis the base alternative, then either additional alternatives should be defined and evaluated or the base alternative accepted as the best course of action.

A strong executive summary is extremely important. It should contain all the essential information needed by the decisionmaker and should be capable of standing alone.